HABITAT USE AND HOME RANGES OF *PODOMYS FLORIDANUS* ON THE ORDWAY PRESERVE

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ABSTRACT

I examined habitat use and home range size of *Podomys floridanus* on the Ordway Preserve, where this species is most common in high pine communities with gopher tortoises (*Gopherus polyphemus*). These communities are subjected to prescribed burns in order to prevent invasion of woody species. Populations of *Podomys* appeared more stable on burned sites than on unburned areas. Home ranges did not alter after prescribed burns and little or no fire-related mortality was indicated. Mean home ranges were 2601 m^2 for 35 females and 4042 m^2 for 40 males. Individuals who survived more than one year on the sandhill utilized the same set of burrows each season. Home ranges of adult females did not overlap, suggesting intra-sexual territoriality.

RESUMEN

Examiné el uso de habitat y tamaño del ámbito de hogar de *Podomys floridanus*, en la Reserva Ordway, donde esta especie es más común en comunidades de pino alto con tortugas excavadoras (*Gopherus polyphemus*). Estas comunidades están sujetas a quemas prescritas con el objeto de prevenir la invasión de especies leñosas. Las poblaciones de *Podomys* parecieron ser más estables en sitios quemados que en áreas no quemadas. Los ámbitos de hogar no fueron alterados después de las quemas prescritas y se detectó muy poca o ninguna mortalidad relacionada con el fuego. El tamaño medio de los ámbitos de hogar fue 2601 m^2 para 35 hembras y 4042 m^2 para 40 machos. Los individuos que sobrevivieron más de un año en las tierras altas arenosas, utilizaron el mismo grupo de cuevas en cada estación. No hubo superposición en los ámbitos de hogar de hembras adultas, lo cual sugiere territorialidad intrasexual.

INTRODUCTION

The Florida mouse, *Podomys floridanus*, is one of the characteristic rodents of the Ordway Preserve. Here *P. floridanus* is known from high pine habitats (i.e. longleaf pine sandhills) and from ecotones between high pine and hammock or high pine and old pasture

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(Brand 1987; Eisenberg 1988; Jones 1990) (Fig. 1). It is closely associated with burrows of the gopher tortoise, *Gopherus polyphemus* (Jones and Franz 1990).

High pine sandhills are pyrogenic communities that were subjected to frequent, cool fires; without fire, these communities convert to xeric hardwoods/mixed pine associations (Myers 1985). Management for longleaf pine on the Ordway now requires systematic prescribed burning on a three-year rotation to mimic the natural fire regime (described for the Preserve by Humphrey et al. 1985). However, aside from the study of the southeastern pocket gopher (*Geomys pinetis*) on the Ordway Preserve (Gates and Tanner 1988), little is known about the effects of fire on small mammals of high pine. Only two studies have examined effects of prescribed burns on *Podomys*. In a 15-month study, Arata (1959) compared trapping success on traplines before (3%) and after (9%) fires in Alachua County. Layne (1990) noted declines of Florida mice 10 years after the most recent fire in both scrub and sandhill sites. He also observed (1990:4) that Florida mice tend to occur in the most open microhabitats available.

Jones and Franz (1990) suggested that the extensive use of tortoise burrows by *Podomys* on the Ordway provided shelter from both fires and the temperature extremes typical of the area. Observations of *Podomys* in and around these burrows led to an investigation of the home range size of these mice, and the question whether these mice maintained territories around tortoise burrows. Among peromyscines, there is considerable variation in reported home range sizes and degrees of territoriality (Eisenberg 1968; Stickel 1968; Wolff 1989). In this study I used Burt's (1943:351) definition of home range: "that area traversed by the individual in its normal activities of food gathering, mating, and caring for young. Occasional sallies outside the area . . . should not be considered as in part of the home range. The home range need not cover the same area during the life of the individual." Territoriality, on the other hand, includes defense by either overt or covert social interaction (Burt 1943). A territory is "a fixed portion of an individual's or group's range in which it has priority of access to one or more critical resources over others which have priority elsewhere or at another time" (Kaufmann 1983:9). To date, the only report of home range size for *Podomys* was that by Layne (1990:9), who compared average distances between successive captures of *Podomys* within trapping periods and noted that home ranges in sandhills (25 m) were larger than those in scrub (16 m).

The natural history of *P. floridanus* is less well-known than that of other North American peromyscines. J. N. Layne has extensively studied ontogeny, parasites, and other aspects of the biology of this species (Jones and Layne 1993 plus citations therein; Layne and Jackson 1994). Results of his work suggest that dependence on tortoise burrows, and other aspects of *Podomys* biology, differ among populations. The purpose of this project was to examine responses to prescribed burns and home range sizes of *Podomys* in high pine habitats on the Ordway Preserve.

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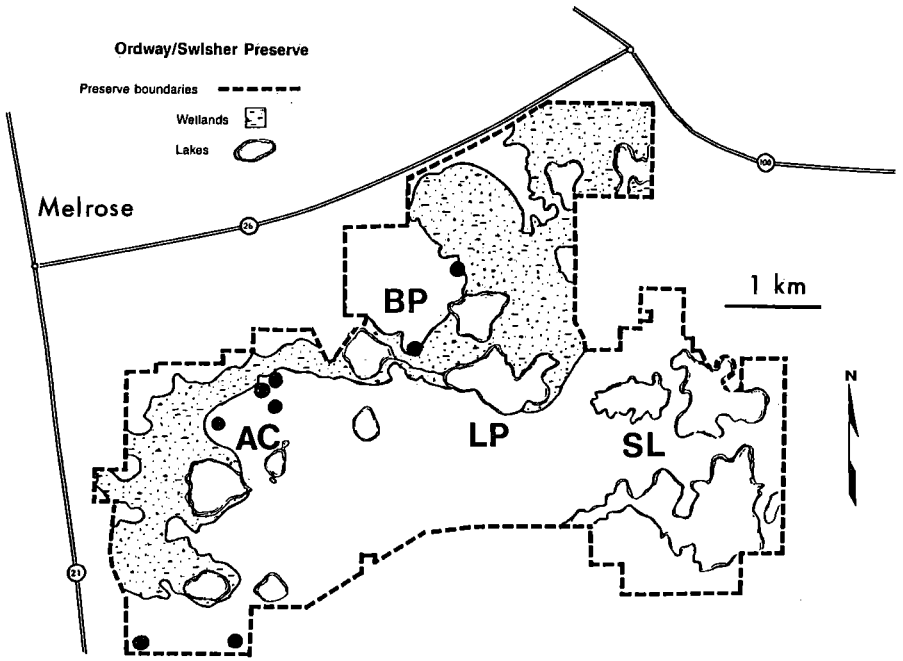


Figure 1. Distribution of *Podomys* on the Ordway/Swisher Preserve. Locations of Anderson-Cue (AC), Blue Pond (BP), Longleaf Pine (LP), and Smith Lake (SL) sandhills are shown. Dots represent additional locations where *Podomys* has been captured.

MATERIALS AND METHODS

I trapped *Podomys* at tortoise burrows and on grids using standard mark-and-recapture techniques (Davis 1956). While trapping at burrows, I placed a pair of Sherman traps (baited with oatmeal) at the entrance, or just inside the entrance. Mice were marked by toe-clipping and weighed; I also noted sex, reproductive condition, and presence of ectoparasites. Animals were released near the entrance, and in most cases I recorded whether they entered the burrow or ran elsewhere. I collected the same data on three grids, one placed on the south side of Smith Lake and two set north and east of the Anderson-Cue ponds. Grids were more than 100 m apart to reduce movement of animals between grids. Each grid consisted of 10 columns and 10 rows 10 m apart (area = 10,000 m^2) with a single Sherman at each intersection. Each burrow and grid intersection was marked, numbered, and mapped. Trapping effort was measured as trapnights (one trapnight being one trap/night).

Traps were opened near sundown and checked at sunrise. Excelsior was provided as insulation during cool weather. Because *Podomys* is susceptible to cold weather (Layne 1969; pers. obs.), trapping began in February or March and ceased in October or November.

Two separate trapping regimes were conducted in order to determine home range size and the effects of prescribed burns. I trapped mice at tortoise burrows before and after

prescribed burns on three independent sandhills (Blue Pond, Longleaf Pine Pasture, and Smith Lake) so I could examine the response to burns. Burrows at Blue Pond were trapped for 2442 trapnights March-November 1988; at Longleaf Pine for 867 trapnights July-November 1987; and at Smith Lake for 3092 trapnights in 1985 (Jones 1990). Eisenberg's unpublished trapping results from Smith Lake (1983) were included in this analysis. These sandhills are on three-year rotations of prescribed burns, but differ in area and seasonality of burns. Trapping results on burned sandhills were compared with those on smaller, neighboring sites that were not burned.

Because trapping effort and area among the three sandhills were unequal, I calculated numbers of individuals per 100 trapnights per hectare. The G-test was used to test the null hypothesis that equal numbers of mice were captured at burned and unburned areas.

I determined the home range sizes on the Ordway sandhills by comparing the results of trapping on grids and at burrows on the Anderson-Cue, Blue Pond, and Smith Lake sandhills. A third technique, the use of fluorescent powder as discussed by Lemen and Freeman (1985), was attempted unsuccessfully (Jones 1990). Two grids on Anderson-Cue were trapped three consecutive nights per month, August 1987-November 1988, for a total of 6400 trapnights. One grid on Smith Lake was trapped for 3900 trapnights, April 1987-November 1988. *Podomys* was trapped at burrows at Anderson-Cue 1986-1988, Blue Pond in 1988, and Smith Lake from 1984 through 1988. As described by Jones (1990), all three sandhills differed in area, vegetation, and elevation.

RESULTS

Numbers of *Podomys* were more constant on burned sandhills than on the unburned areas, although estimated densities fluctuated on all three sandhills (Fig. 2). Apparent densities of *Podomys* at unburned burrows occasionally appeared high, which seemed to be an artifact of the small area of unburned sandhill; all animals captured on the three unburned sandhills were captured on edges of the unburned areas. More individuals were caught in burned areas following a fire (Table 1). Significantly more individuals were captured on burned sites than at unburned burrows ($G = 10.597$, $p < 0.005$). There was no significant difference in trapping success between the three months immediately preceding and following the burns. Home ranges of 13 animals captured at least five times on burned areas did not significantly shift or change in size following the fire. There was little or no evidence of mortality directly attributable to fire. On Smith Lake, 87% of the 15 individuals trapped the month before the burn were captured the month after the fire; on Blue Pond and Longleaf Pine, all mice trapped before the fire were captured the month after (i.e. 100% survivorship).

Trapping success on burned and unburned sites also was compared by examining trapping effort expressed as trapnights per total number of captures per hectare (Table 2); i.e. how much effort was required in an area to trap a mouse. No effort was made to make trapnights equivalent. Regardless of the total number of trapnights, more time was needed to catch a mouse on the unburned sites. For all five years on the Smith Lake sandhill, the numbers of trapnights required to catch a mouse were much lower and more consistent year to year on the burned area than on the unburned area.

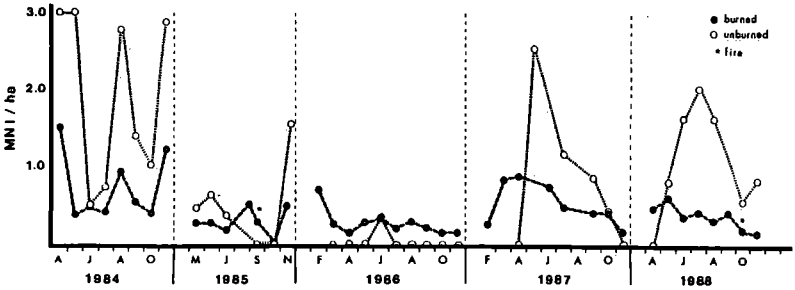


Figure 2. Apparent densities (expressed as minimum numbers of individuals/ha) of *P. floridanus* on the burned and unburned areas of the Smith Lake Sandhill.

Table 1. Data obtained from trapping *Podomys* at burrows (n) subjected to prescribed burns on Blue Pond, Longleaf Pine, and Smith Lake sandhills. MNI is number of individuals caught.

	Pre-burn	Post-burn
Blue Pond (n = 26)		
Trapnights	416	676
MNI	10	8[a]
Total captures	24	28
Longleaf Pine (n = 24)		
Trapnights	318	174
MNI	5	5[b]
Total captures	7	5
Smith Lake (n = 57)		
Trapnights	558	805
MNI	15	19[c]
Total captures	44	37

[a] includes 4 individuals captured before the burn.
[b] includes 2 individuals captured before the burn.
[c] includes 10 individuals captured before the burn.

In the study of home range, persistence (the number of days from first to last capture) ranged from 1 to 75 days for 10 females and 8 males captured on the Anderson-Cue grids, and from 1 to 75 days for 10 females and 14 males captured on the Smith Lake grid. The largest population occurred on the Smith Lake grid in the spring of 1987 and 1988, when there were 8 individuals. Excluding animals caught three times or less, mean persistence time on this grid was 196 days for females and 137 days for males.

Table 2. Comparison of trapping effort on unburned and burned sandhills, where TN is the total number of trapnights and trapping effort is expressed as trapnights/capture/ha.

Unburned site	Year	TN	trapnights/capture/ha
Blue Pond	1988	830	19.53
Longleaf Pine	1987	371	51.53
Smith Lake	1984	476	7.39
	1985	784	14.74
	1986	786	280.71
	1987	429	15.32
	1988	704	8.38
Burned site---Blue Pond	1988	1612	8.70
Longleaf Pine	1987	492	6.51
Smith Lake	1984	1444	0.64
	1985	2308	1.00
	1986	2958	1.17
	1987	1839	0.99
	1988	2789	1.02

I determined whether ranges of females and males overlapped on grids by plotting home ranges of *Podomys* caught during May 1987 (n=6 animals) on Anderson-Cue and May 1987 (n=8), September 1987 (n=7), and May 1988 (n=9) on Smith Lake, the three months during which populations appeared to be the largest. All mice were captured four or more times on grids. I calculated the home range area using the Exclusive Boundary Strip Method, in which a boundary is plotted as half the distance between adjacent traps (Stickel 1954). Home range data are summarized in Tables 3 and 4. Three animals were marked on the grids as juveniles (gray pelage) and died or dispersed off the grid at approximately 60 days of age. Two more animals (female 26 and male 54 at Smith Lake) marked as juveniles did not leave the grid. The male shifted his home range, but I could not distinguish between juvenile and adult home ranges for female 26, who subsequently appeared to have an activity area larger than that of other females. Generally, ranges of males and females overlapped, but ranges of adult females did not (except occasionally with juveniles or young adults), a pattern which suggests intra-sexual territoriality (Kaufmann 1983). A female juvenile overlapped with the ranges of an adult of each sex. Female 26, the one with the unusually large range, overlapped somewhat with another adult female in September 1987. Seventeen adults trapped on the Smith Lake grid and one Anderson-Cue grid had an average home range of 804 m^2. In general, males (mean = 910 m^2) appeared to have larger home ranges than females (mean = 683 m^2), but the difference was not significant (Mann-Whitney test at $p = 0.01$).

I also estimated home ranges of adults trapped more than four times in a year at burrows on Anderson-Cue and Smith Lake, using the exclusive boundary method (Stickel 1954) as I did for grids. The boundary was set as equal to half the distance between burrows, and for burrows on the perimeter of the study site, I plotted a boundary of 10 m (a conservative estimate of distance moved beyond the burrow). All capture points were weighted equally, but in a few instances I omitted points that suggested unusual forays outside the usual home range of the animal.

Table 3. Home range data for 20 *Podomys* trapped on two grids. ID indicates sex and identification number, N_G is number of captures, P_G is persistence on grid in days, A is area of the home range in m^2 for juveniles (A_J) and adults (A_A).

Grid	ID	N_G	P_G	A_A	A_J
ACI	F89	6	21	700	
ACI	F91	7	75	500	
ACI	F96	4	21	400	
ACI	F94	6	21	916	
ACI	M95	5	21	750	
ACI	M96	5	21		800
SL	F61	5	24	1000	
SL	F10	6	42		500
SL	F18	6	36		600
SL	F26	17	449	1350	
SL	F47	12	517	300	
SL	F54	6	74	300	
SL	M42	8	289	1850	
SL	M49	10	91	1200	
SL	M54	16	381	1093	200
SL	M16	9	148	800	
SL	M53	6	76	600	
SL	M56	7	44	500	
SL	M59	8	74	1000	
SL	M102	10	156	400	

Seventy-one home ranges for 62 animals who fit the above criteria are shown in Figure 3. Home ranges for adult males frequently overlapped, but those of females did not; two Smith Lake females who appear to overlap in 1988 actually were separated temporally. This separation of home ranges, similar to that observed on grids, suggests intra-sexual territoriality. Home ranges varied in size from 210 m^2 (for Smith Lake female 26, captured at a single burrow 6 times in 1987) to 11007 m^2 (for Smith Lake male 11 in 1986). The average home range size for 35 females was 2601 m^2 (SD = 1315.1) and for 40 males was 4042 m^2 (SD = 2269.4); home ranges of the two sexes differed significantly (Mann-Whitney U = 2.95, $p = 0.01$). For the Smith Lake data I also compared areas in 1983-1985 with those of 1986-1988 to see whether home range size changed after the prescribed burn in 1985, but I found no significant difference.

Capture data for 75 adults are shown on Table 5. Females 86, 94, and 97 (1987) were from Anderson-Cue; the remaining animals were on Smith Lake. Each animal was trapped from 5 to 22 times during the year in question, and almost all mice utilized more than one burrow (mean number of burrows = 3.8). Estimates of persistence (the number of days between first and last captures) are minimal estimates of persistence on the sandhill; they are not comparable across years because trapping effort varied each year, nor do they represent longevity because captures of juveniles and subadults (or captures as adults in years other than those shown) are excluded.

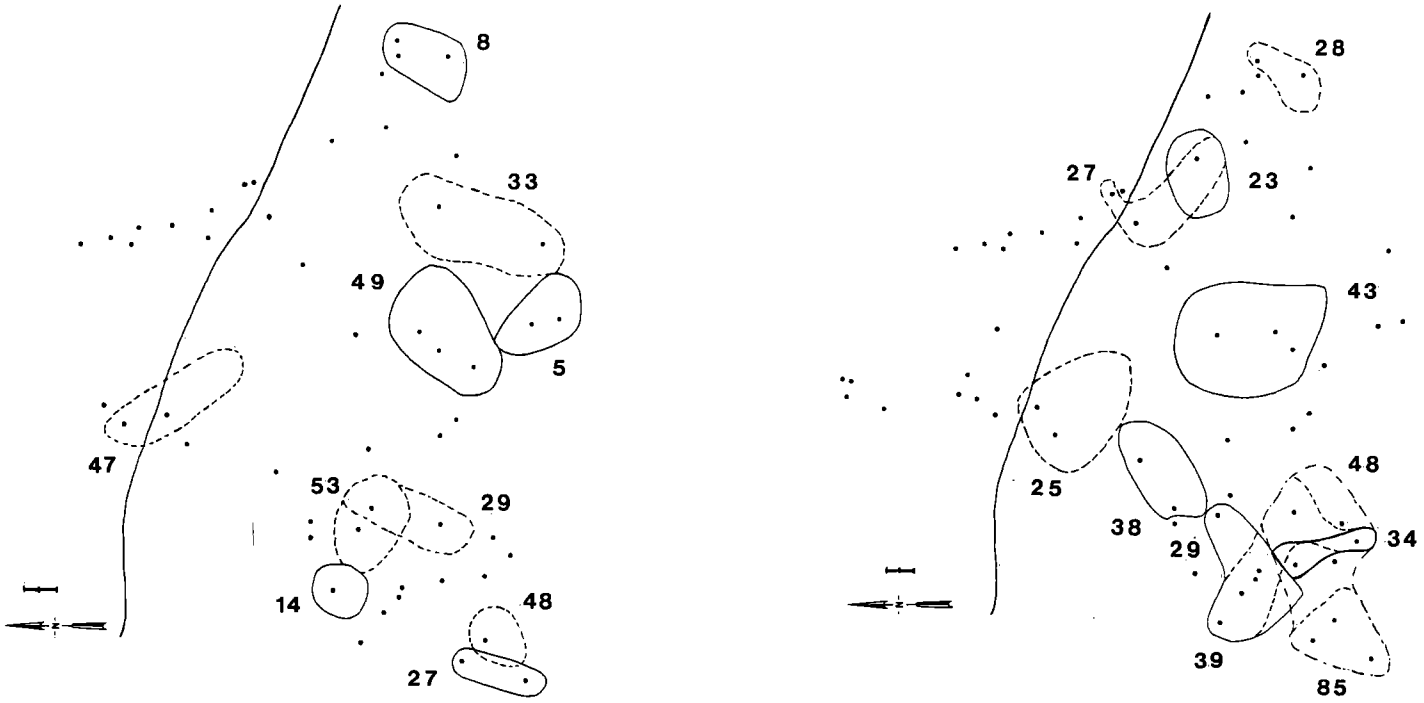


Figure 3. Annual home ranges of 62 *Podomys* on the Smith Lake sandhill 1983-1988. Dots represent tortoise burrows where mice were trapped. Solid lines indicate home ranges of females, broken lines for males. (a) 1983, 52 burrows; (b) 1984, 61 burrows. Bar represents 20 m.

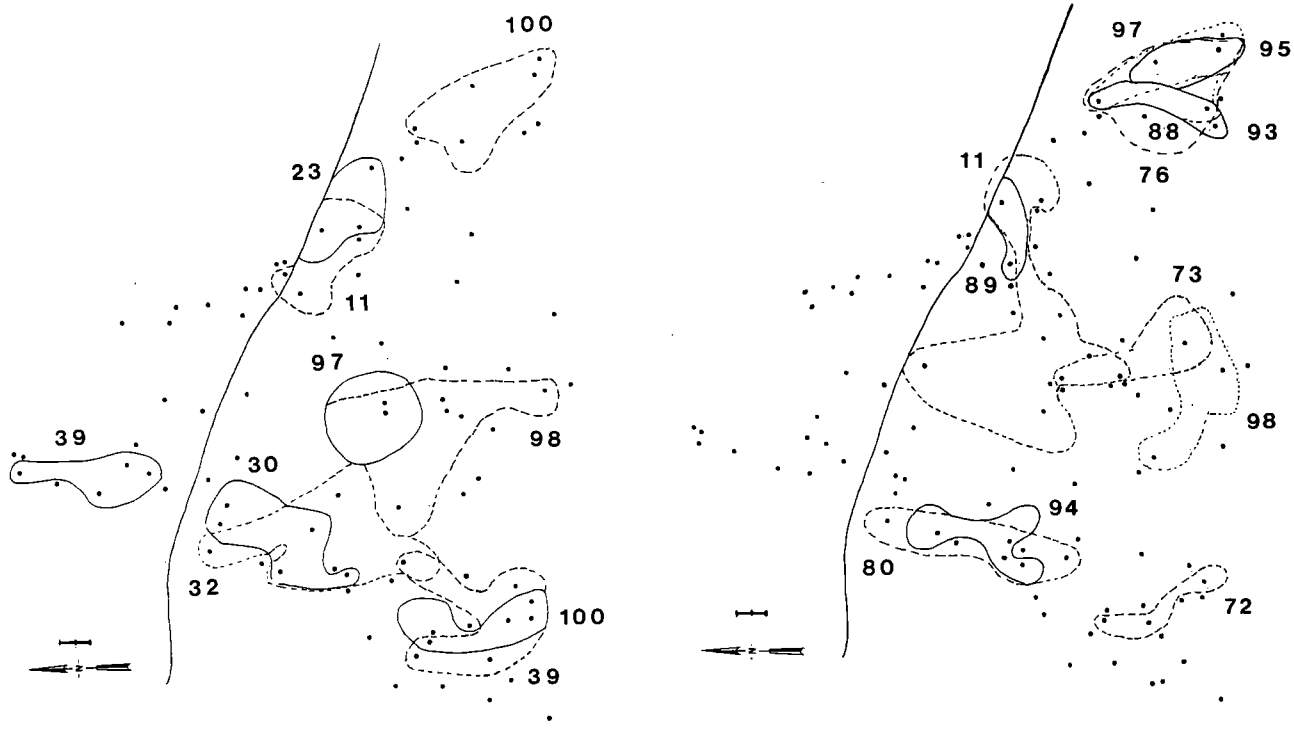
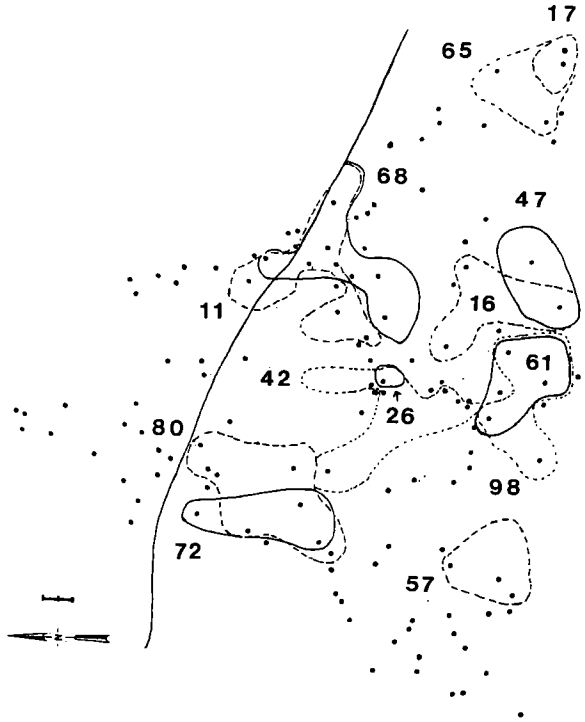


Figure 3. Continued. (c) 1985, 89 burrows; (d) 1986, 103 burrows. Bar represents 20 m.



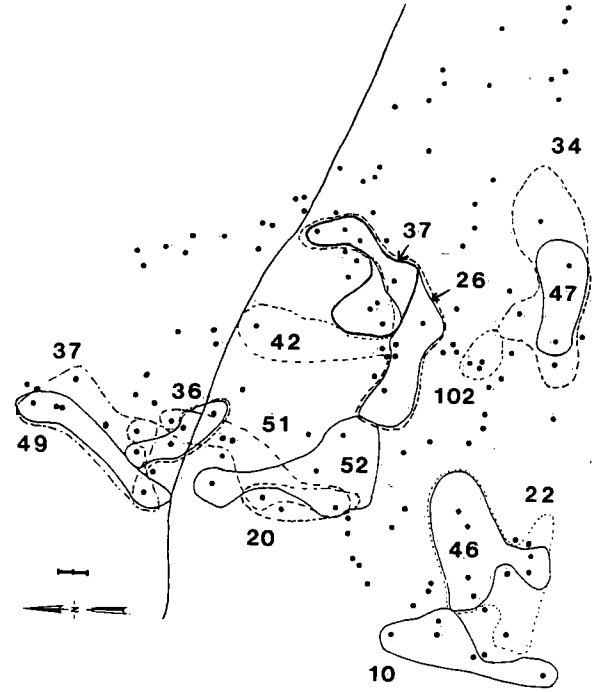


Figure 3. Continued. (e) 1987, 131 burrows; (f) 1988, 136 burrows. Bar represents 20 m.

Table 4. Capture data for 36 *Podomys* at Anderson-Cue. ID indicates sex and identification number; YR is year of first capture; AGE is age at first capture (J=juvenile, SA=subadult, or A=adult); N is number of captures at grids (N_G), burrows (N_B), and total (N_T); P is persistence in days on grids (P_G), burrows (P_B), and total (P_T). Asterisks indicate trap mortality.

ID	YR	AGE	N_B	P_B	N_G	P_G	N_T	P_T
F83	88	J	1			1	1	1
F84	88	J	3	3			3	3*
F85	88	J			1	1	1	1
F86	88	A	7	109			7	109
F87	88	SA	2	2	5	33	7	33
F88	87	A	1	1	3	3	4	9
F89	87	A			6	21	6	21
F90	87	SA	1	1			1	1
F91	87	SA			7	75	7	75
F92	87	A			1	1	1	1
F93	87	A	1	1			1	1
F94	87	A	7	164	1	1	8	164
F95	87	A	1	1	3	3	4	21
F96	87	A	1	1	4	21	5	40
F97	87	A	9	171	3	3	12	193
F98	87	J	1	1			1	1
F99	87	A	1	1			1	1
F100	87	SA	4	124			4	124
M80	88	SA	3	216			3	216
M84	88	A	2	39	2	3	4	39
M85	88	SA	3	101			3	101
M86	88	SA			1	1	1	1
M87	88	SA	2	2			2	2
M40	87	A	1	1			1	1
M88	87	J	1	1			1	1
M89	87	J			1	1	1	1
M90	87	J	1	1			1	1
M92	87	A	3	48	2	2	5	48
M93	87	SA			3	5	3	5*
M94	87	A	2	106	6	21	8	106
M95	87	A			5	21	5	21
M96	87	J			5	21	5	21
M97	87	A	4	150			4	150
M98	87	?	1	1			1	1
M99	87	SA	1	1	3	3	4	21
M100	87	A	1	1			1	1

From August 1983 to November 1988, 255 *P. floridanus* were toe-clipped on the Smith Lake sandhill. Of these, 12 females and 10 males (8.6% of the total) were present for more than 360 days. Male 11 was the longest-lived, persisting for more than 920 days. Animals who survived for more than one year (e.g. male 11 in 1985-87, Fig. 3) showed fidelity to the same general area every year.

Table 5. Capture data for 75 adult *Podomys*. ID is the sex and identification number of each mouse; YEAR is the year for which the home range was calculated; N_B is the number of captures, P_B is persistence (in days); $\#_B$ is the number of burrows where each animal was caught; and asterisks denote animals present when trapping ceased in November 1988.

ID	YEAR	N_B	P_B	$\#_B$
F5	1983	5	93	2
F8		6	71	3
F14		6	71	2
F27		5	114	2
F49		5	117	4
M29		5	79	2
M33		5	79	2
M47		5	99	2
M48		5	100	1
M53		5	79	2
F23	1984	8	125	2
F29		11	139	5
F34		5	56	2
F38		5	49	2
F43		15	222	3
M25		6	135	3
M27		5	61	3
M28		5	63	2
M39		14	171	5
M48		12	211	8
M85		6	99	3
F23	1985	14	212	3
F39		12	84	4
F30		8	183	5
F97		8	185	3
F100		22	265	5
M11		16	253	5
M32		13	183	6
M39		18	265	7
M98		13	265	6
M100		7	100	5
F89	1986	5	49	2
F93		5	36	3
F94		8	103	4
F95		6	107	2
M11		19	253	8
M72		5	68	3
M73		7	79	3
M76		11	133	7
M80		12	103	7
M88		16	259	4
M97		5	101	3
M98		5	171	3
F26	1987	6	78	1
F47		8	113	2

Table 5 Continued

ID	YEAR	N_B	P_B	$\#_B$
F61		7	243	3
F68		6	170	5
F72		5	125	3
F86		7	109	4
F94		7	164	6
F97		9	171	8
M11		8	143	5
M16		7	233	3
M17		5	193	2
M42		5	31	5
M57		9	242	3
M65		7	213	4
M80		9	201	5
M98		5	218	4
F10	1988	11	227*	4
F26		14	193	6
F36		5	94	3
F37		9	121	5
F46		10	151	5
F47		11	193	2
F49		8	148*	3
F52		11	151	5
M20		8	151	4
M22		8	151	7
M25		7	132	4
M34		6	104	4
M37		9	148*	5
M42		11	198*	7
M51		10	151	4
M10		13	198*	2

DISCUSSION

Prescribed burns on the Ordway Preserve had no immediate impacts on mortality or the size and locations of home ranges of *Podomys*. More trapping effort was required to capture mice on the unburned sites and, over a period of several years, numbers of *Podomys* on unburned sites appeared less predictable and less stable than numbers on burned areas. On the unburned areas, all mice were captured at peripheral burrows (on the edge of unburned sandhill near old pasture or burned sandhill habitats), and in some years no animals were captured on these areas. Additional experiments with more replications (and burned and unburned sites of equal area) are needed, but these might be difficult to perform at Ordway, given the large home ranges and fluctuating populations of these animals. The immediate response of *P. floridanus* to the prescribed burns on the Ordway appears to be neutral (Jones 1992). However, it is clear that the cessation of fire allows conversion of high pine to xeric hardwood or mixed pine forests (Laessle 1958; Myers 1985) in which

Podomys is absent. Prescribed fires maintain the open habitat and the tortoise populations on which these mice rely on the Ordway Preserve.

Trapping on grids provided estimates of home range size and persistence, as well as demonstrating the exclusivity of home ranges of adult females. There also was evidence that males had larger home ranges that occasionally overlapped with each other and with females. However, results from trapping at burrows suggest that estimates from grids were too small. Evidently the "standard" mammal-trapping grid (10000 m^2 with 10-m trap intervals) was insufficient to measure home ranges of *Podomys* in sandhills. Doubling the trap interval to 20 m would produce a grid covering 40000 m^2, which would encompass mean home ranges estimated at burrows for females (2601 m^2) and males (4042 m^2), might be more useful. No fewer than 100 trap stations should be used. However, increasing grid size on some sandhills will spread the grid into neighboring habitats.

Estimates of home range produced by trapping at burrows were comparable with values reported for *Peromyscus*. Stickel (1968) reported that home ranges of *Peromyscus* varied from 0.1 to 10 acres. Hoffmeister (1981) reported mean home ranges for female (8290 m^2 +/- 2688) and male (10465 m^2 +/- 4043) *P. truei* in pinon-juniper habitat, also using the exclusive boundary strip method. Although the range of home areas of *Podomys* varies considerably, further research might show that my means are underestimates, based as they are on many individuals located on the edges of my study sites. I also have no measure of vertical habitat use; for example, it would be interesting to determine whether the mice occupy a larger home range *volume* in years when acorns are produced.

In analyses of both burrow and grid data, I omitted animals that were recaptured less than three times. A possible consequence of this approach is that several animals might occupy the same space. However, the fact that both sets of data show abutment of home ranges of adult females seems good evidence of mutually exclusive home ranges, which suggests that females might be territorial.

LITERATURE CITED

Arata, A. A. 1959. Effects of burning on vegetation and rodent populations in a longleaf pine turkey oak association in north central Florida. Quart. J. Florida Acad. Sci. 22:94-104.

Brand, S. M. 1987. Small mammal communities and vegetative structure along a moisture gradient. M.S. Thesis, Univ. Florida, Gainesville, 99 pp.

Burt, W. H. 1943. Territoriality and home range concepts as applied to mammals. J. Mamm. 24:346-352.

Davis, D. E. 1956. Manual for analysis of rodent populations. Privately published. Baltimore, Maryland, 82 pp.

Eisenberg, J. F. 1968. Behavior patterns. Pp. 451-495, *in* J. A. King, ed. Biology of *Peromyscus* (Rodentia). Spec. Publ., Amer. Soc. Mamm. 2:1-593.

_____. 1988. Mammalian species of the Ordway Preserve. A reference for students. Ordway Pres. Res. Ser., Florida Mus. Nat. Hist.. Rept. No. 1, 67 pp.

Gates, C. A., and G. W. Tanner. 1988. Effects of prescribed burning on herbaceous vegetation and pocket gophers (*Geomys pinetis*) in a sandhill community. Florida Sci. 51:129-139.

Hoffmeister, D. F. 1981. *Peromyscus truei*. Mamm. Species 161:1-5.

Humphrey, S. R., J. F. Eisenberg, and R. Franz. 1985. Possibilities for restoring wildlife of a longleaf pine savanna in an abandoned citrus grove. Wildl. Soc. Bull. 13:487-496.

Jones, C. A. 1990. Microhabitat use by *Podomys floridanus* in the high pine lands of Putnam County, Florida. Ph.D. diss., Univ. Florida, Gainesville.

_____. 1992. Review of the effects of fire on *Peromyscus* and *Podomys*. Florida Sci. 55:75-84.

Jones, C. A., and R. Franz. 1990. Use of gopher tortoise burrows by Florida mice (*Podomys floridanus*) in Putnam County, Florida. Florida Field Nat. 18:45-51.

Jones, C. A., and J. N. Layne. 1993. *Podomys floridanus*. Mamm. Species 427:1-5.

Kaufmann, J. H. 1983. On the definitions and functions of dominance and territoriality. Biol. Rev. 58:1-20.

Laessle, A. M. 1958. The origin and successional relationship of sandhill vegetation and sand-pine scrub. Ecol. Mono. 28:361-387.

Layne, J. N. 1969. Nest-building behavior in three species of deer mice, *Peromyscus*. Behaviour 35:288-303.

_____. 1990. The Florida mouse. Pp. 1-21 *in* C. K. Dodd, Jr., R. E. Ashton, Jr., R. Franz, and E. Wester, eds. Burrow associates of the gopher tortoise. 8th Ann. Mtg. Gopher Tortoise Council, Florida Mus. Nat. Hist., Univ. Florida, Gainesville, 134 pp.

_____, and R. J. Jackson. 1994. Burrow use by the Florida mouse (*Podomys floridanus*) in south-central Florida. Amer. Midl. Nat. 131:17-23.

Lemen, C. A., and P. W. Freeman. 1985. Tracking mammals with fluorescent pigments: a new technique. J. Mamm. 66:134-136.

Myers, R. L. 1985. Fire and the dynamic relationship between Florida sandhill and sand pine scrub vegetation. Bull. Torrey Bot. Club 112:241-252.

Stickel, L. F. 1954. A comparison of certain methods of measuring ranges of small mammals. J. Mamm. 35:1-15.

_____. 1968. Home range and travels. Pp. 373-411 *in* J. A. King, ed. Biology of *Peromyscus* (Rodentia). Spec. Publ., Amer. Soc. Mamm. 2:1-593.

Wolff, J. O. 1989. Social behavior. Pp. 271-291 *in* G. L. Kirkland, Jr., and J. N. Layne, eds. Advances in the study of *Peromyscus* (Rodentia). Texas Tech Univ. Press, Lubbock, 366 pp.